

APPARATUS AND METHOD FOR COMBINING LIQUIDS AND FILLERS FOR SPRAY APPLICATION

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The invention relates in general to a method for metering a filler material and combining the filler material with a liquid. The invention is also directed to the pourable or sprayable composition prepared by the method, as well as a spray nozzle for spraying the composition. The invention also relates to methods of lining or resurfacing the surfaces of a wide range of commercial, industrial and consumer products with the liquid composition containing fillers.

Description of the Related Art

[0002] There is a continuous and increasing need for inexpensive and durable surfaces made by precise combination of liquid, such as a polymer, with any number of solids or fillers. U.S. patents to Hall et al 5,307,992; Mathias et al 5,565,241; and Scarpa 5,979,787, all disclose methods for combining liquids and fillers for pouring or spraying, including disclosure of separate containers for holding the components of a two or more component system. However, these patents disclose conventional means for holding and feeding the dry filler material/filler into the cavity of a spray gun, such as holding the filler in a hopper and feeding it via gravity and sometimes pressure, into tubes connected to a spray gun.

[0003] U.S. patents to Mobley et al., No. 1,849,945; Thompson, No. 2,981,308; Tufts, No. 3,606,154; Medlin, No. 4,630,929; Daluise, No. 6,159,550; and Vass Nos. 4,590,218 and 5,532,281 also disclose systems for combining fillers and liquids for spraying and/or pouring, in which a compressed fluids source is utilized to feed a particulate material from a tank or hopper to a spray gun. In particular, Thompson disclosed a compressed air tank which pushes both the particulate/binding materials through separate conduits to a discharge gun nozzle. Tufts disclosed a similar system

although a blower and pump are used. Medlin disclosed a liquid (asphalt emulsion) that exited ports under pressure, mixed in a conduit with a material (e.g., rock, stone, gravel and baked clay) and was carried in a conduit by an air stream. Daluise disclosed a liquid binder stored in a holding tank which was connected to a gun nozzle and to a hopper which held rubber particulate. Vass disclosed introducing a gas into a liquid component followed by introduction of a filler. Upon collapse of the polymer, the resulting product, a polymer containing a filler, had a density of 95lbs/ft³. However, all of these patents disclosed a liquid component/binder and a filler particulate mixed within the spray gun prior to reaching the nozzle head. This mixing of the components often leads to a blocked spray gun, which greatly increases the time and expense of the spray application.

[0004] German patent 1,577,773 to Hill also disclosed an apparatus and method for combining liquids and fillers for spray application. Hill's apparatus included a tank for holding a particulate material which was gravity fed to a spray gun assembly via a hose and an air stream. The particulate spray was disclosed as being expelled from the gun via a central nozzle while the liquid components were sprayed via two separate nozzles in a direction toward the particulate spray, so as to mix with the particles.

[0005] U.S. patents to Uribe, No. 5,213,271 and Reimer, No. 5,282,573, both disclosed powder spray coating systems in which the powder was removed from a tank or hopper via an air stream. Uribe further disclosed a metering roller for metering the powder. Reimer disclosed a flame spray coating system including a powder supply hopper, an eductor to entrain the powder in a stream of conveying air, and a valve for controlling the flow of powder from the hopper into the eductor.

[0006] U.S. patents to Moller, No. 2,565,696; Lippert et al., No. 3,251,550; Sandell, No. 4,263,346; Shockley, No. 3,799,438; Williams, No. 5,167,285; and Scarpa et al., No. 5,964,418, all disclosed spray nozzles of having an inner circumferential chamber for carrying a liquid and an outside chamber for carrying a filler material.

[0007] One of the problems with the previous patents disclosing the spraying of a combination of liquids and fillers is that only low density compositions were sprayed.

Another problem with the traditional methods and equipment for spraying a combination of liquids and fillers is the use of a high velocity to spray the combination. It is preferable to use a low pressure during the application process of the present invention. First, a high pressure/velocity causes the fillers to bounce away from where the liquid is being sprayed and thus would not be combined with the liquid. Second, spraying at low pressures allows for the use of inexpensive standard hoses, not requiring highly abrasion resistant hoses.

[0008] Another of the problems with the previous methods of combining a liquid material, such as polyurethane with a filler, such as sand, is that the liquids and fillers are difficult to combine when the liquid content is low and/or the filler content is high or when the fillers and liquids do not mix uniformly. Previous methods disclosed introduction of the filler by gravity. Gravity fed filler materials prove problematic in that they have varying discharge rates (as the tank empties, the weight above the opening drops, and the flow rate decreases). Uneven introduction of a filler material to a liquid composition inhibits complete mixing of the filler and liquid. Another common means of supplying the filler material is from a pressurized tank with a bottom opening. By pressurizing the tank, to over 30 psi, the variation seen in the discharge rate when the tank is emptying is reduced. However, since such high pressures are used, the hoses and valves used must be designed to withstand the wear created by the filler materials. Furthermore, the valves are commonly kept open and are remotely closed, adding to the complexity of the equipment. The present invention also does not require the tank containing the filler material to be elevated to allow space for a valve and plumbing under the tank, nor are complex controls needed as is required with higher pressure systems.

[0009] A further problem with previously used methods of combining a liquid and filler is the use of compositions made of epoxy and other catalyzed coatings, including those containing abrasive and related materials, are generally mixed prior to application and applied with a pump or compressed air spray apparatus. This requires a minimum level of viscosity that comprises dry/cure time, abrasive content, material cost, and the final strength, durability, and other attributes of the final product. Mixing the filler and

liquid materials at the point of application, as in the present invention, also minimizes material waste and to simplify equipment cleanup. Thus, the prior methods do not represent a reliable or flexible technology; necessitate extra expense and frequent user intervention and generate maintenance problems.

[0010] The ideal liquid composition for use as a coating or liner would contain fillers, such as sand and other fillers, that could be poured or sprayed, would be easy to use, quick to activate, allow for even mixtures of fillers with the liquids, allow for varying densities between the fillers and liquids, and have a long service life. Also of great importance is the cost, performance and durability of such polymer formulations. Currently, there does not exist a method of making a liquid composition containing fillers that satisfies all these criteria.

Brief Summary of the Invention

[0011] The present invention discloses a method of combining at least one liquid composition with at least one filler material, comprising: providing the filler into a pressurized container having a conduit having an orifice whereby the filler leaves the container; providing liquid in a container; metering the filler by varying the pressure in the container, the diameter of the conduit's orifice, or a combination thereof; providing a hose connected on one end to the liquid container and a hose connected on one end to the filler container and the other ends of the liquid and filler hoses connected to a spray gun assembly whereby to pass the metered filler and liquid; and separately passing the liquid component and the metered filler component through the spray gun assembly, wherein the liquid component and the filler component are sprayed and combine. The liquid component is about 15 - 40% by weight of the total composition. The filler material makes up about 60 - 80% by weight of the total composition. The filler material is chosen to add predetermined physical and chemical properties to the liquid component, thus, the total composition varies depending on intended use of the final product sprayed.

[0012] In another embodiment, prior to the metering of the fillers, the filler is fluidized by creating a space inside the holding tank so that when the filler, e.g., sand, is sucked

into the orifice of a conduit, located in the tank, the filler travels against gravity (Figure 3 and 4).

[0013] In yet a further embodiment, a spray gun nozzle is disclosed for spraying at lower pressures and for spraying thinner viscosity compositions. The spray gun nozzle has a cylindrical housing through which the filler material is blown and surrounds a supporting pipe. The supporting pipe in turn surrounds and supports the static mixer and keeps the static mixer straight. A retaining nut (Fig.13a-b) having an external thread and an internal thread retains and receives both the supporting pipe and the static mixer. The external thread of the retaining nut is connected to the internal thread of the cylindrical housing. The internal female thread of the retaining nut is connected to the male thread of a manifold of a commercially available spray gun. The manifold is a valve system involving ball valves and check valves to allow the components to come together and includes a handle for on/off control of the material supply through the manifold.

[0014] The combining of and uniform mixing of liquid compositions and filler materials has several beneficial applications, e.g., the resurfacing of industrial floors, asphalt repair, and lining surfaces. Since the composition of the present invention can be applied quickly and seamlessly, it requires less time of the applicator, as well as less time for any necessary production shut down. The present invention's ability to minimize the volume of liquid required, combined with its improved mixing action, helps improve the mechanical properties of the substances applied with it, as well as minimizing drying times and the release of volatile organic compounds and other pollutants. Other applications of the present invention include the spraying of high strength Portland cement; the application of roofing compositions that are odorless, waterproof, and that may be applied at cooler temperatures than conventional asphalt roofing. The method and compositions of the present invention can also be used for maintaining asphalt, e.g. by filling in cracks with the composition, making high traction bridge decks and floor coatings. The composition of the present invention also described treatment of the filler material with a polymer. The treated filler allows a



hydrophilic filler to repel water, which is beneficial to coating applications and allows for easier packaging of the composition of the present invention into kits.

[0015] These and other features, aspects, and advantages of the present invention will become better understood with regard to the following detailed description, appended claims, and accompanying drawings.

Brief Description of the Drawings

[0016] FIG. 1 is a schematic of the apparatus of the present invention showing the conduit inside the holding tank of the filler material, the conduits from the air compressor to the holding tank;

[0017] FIG. 2 is a broken away cross-sectional view of a filler/liquid impingement spray gun showing the intersection and combination of the liquid and filler components;

[0018] FIG. 3 is a schematic of another embodiment of the apparatus of the present invention showing of the filler material holding assembly;

[0019] FIG. 4 is a broken away cross-sectional view of the spacing device and the orifice of FIG. 3, from which the filler material leaves the filler material holding assembly;

[0020] FIG. 5 is a cross-sectional view of a impingement spray gun showing the inner and outer chamber of the spray nozzle;

[0021] FIGS. 6a-d are broken away cross-sectional views of the impingement spray gun of FIG. 5, showing the nozzle tip, (Fig.6a) the supporting pipe, the nut (Fig.6c) and the inlet for liquid composition (Fig.6d);

[0022] FIG. 7 is a broken away cross-sectional view of the impingement spray gun of FIG. 5 showing the passageway of a two component liquid composition and the passageway of the filler component material;

[0023] FIG. 8 is a cross-sectional view of the impingement spray gun of FIG. 5 showing an enlarged view of the spray nozzle and spray tip;

[0024] FIG. 9 is a cross-sectional view of the outer wall of the spray impingement gun of FIG. 5;

[0025] FIG. 10 is a cross-sectional view of the conduit having a funnel shaped orifice;

[0026] FIG. 11 is a conduit having an inverted round-shaped orifice;

[0027] FIG. 12 is a conduit having a round-shaped orifice; and

[0028] FIG. 13a-b is a drawing of the retaining nut (Fig. 13a) and cross-sectional view of the retaining nut (Fig. 13b).

Detailed Description of the Invention

[0029] The present invention provides a method of metering and combining a liquid and at least one filler to form a pourable or sprayable composition. The liquid component and the filler component are largely mixed at the point of application. The present invention also provides an apparatus 10 of metering and combining a liquid and at least one filler 14 to form a pourable or sprayable composition.

[0030] The liquid component is contained within any suitable container 16. For reactive liquid mixtures, separate containers 16 are used (Fig. 1). The liquid component that can be used is: water; solvent; plasticizer; paint; glue; polymer; Portland cement slurry; asphalt emulsion; polymer latex; epoxy; polyester; polyurethane; methacrylate; a moisture-cured urethane polymer or a combination thereof. If polyurethane is used as the liquid, any commercially available polyurethane may be used. Any of the organic polyisocyanates used in the art to prepare polyurethanes and polyurea-containing polyurethanes can be used, for example: hexamethylene diisocyanate; m-xylylene diisocyanate; toluene diisocyanate and/or any of its isomers such as 2,4-toluene diisocyanate or commercially available blends of the 2,4- and 2,6-isomers such as the 80:20 and 65:35 blends; polymethylene polyphenylisocyanate; 4,4'-diphenylmethane diisocyanate; m-phenylene diisocyanate; p-phenylene diisocyanate; 3,3'-dimethyl-4,4'-diphenyl diisocyanate; methylenebis (2-methyl-p-phenylene) diisocyanate; 3,3'-dimethoxy-4,4'-biphenylene diisocyanate;

2,2',4,4'-tetramethyl-4,4'-biphenylene diisocyanate; 3,3'-dimethyl-4,4'-diphenylmethane diisocyanate; 4,4'-diphenylisopropylidene diisocyanate; 1,5'-naphthylene diisocyanate; and polymethylene polyphenylisocyanate.

[0031] A portion of the polyisocyanate, i.e., the polyisocyanate on the "A" side, can be pre-reacted with a polyol so as to form a prepolymer or quasi-prepolymer, in which essentially all the terminal groups are isocyanate groups. Any of the polyols used in the art to prepare polyurethanes and polyurea-containing polyurethanes can be used, for example: a polyol chosen from a variety of OH terminated polyethers such as the polyoxyalkylene polyols having 2-4 hydroxyl groups and where the alkylene group has 2-6 carbon atoms, obtained by polymerization of an alkylene oxide, such as ethylene oxide, propylene oxide, or butylene oxide, with a glycol; polyethers having higher functionality obtained by reaction with a triol or higher polyol, such as glycerine, trimethylolpropane, and pentaerythritol, polypropylene-oxide triol, triethanolamine and diethanolamine.

[0032] Also, if a polyurethane liquid is used it is preferred to also use a catalyst having polyol as well as amine functionality, for example, amine catalysts with three hydroxyl groups. Such catalysts are typically derivatives of ammonia and alkylene oxides, for example, triethanolamine derived from ammonia and ethylene oxide, or triisopropanolamine derived from ammonia and propylene oxide. Ethylene diamine and alkylene oxide reaction products can also be used. For example, Quadrol® (BASF Wyandotte) is based on the reaction of ethylene diamine and propylene oxides. Combinations could also be used. Products of the reaction of other aliphatic diamines with ethylene or propylene oxide also can be used. Although triisopropylamine is preferred, other catalysts which promote the reactive combination of hydroxyl and isocyanate groups to the exclusion of a water-isocyanate reaction can be used instead of, or in addition to, triisopropylamine. Such catalysts include lead (e.g. lead octoate), mercury, bismuth, tin, and ferric acetylacetonate.

[0033] The filler material 14 used is preferably sand, although the sand can be substituted with glass beads; garnet; aluminum oxide; fibers, such as KEVLAR or

carbon fullerenes; tungsten carbide; powdered plastics; ceramic spheres; powdered metals; hollow spheres; other fillers having from about 12 to 100 mesh, or a combination thereof. The sand can be either a natural or manufactured sand, although natural sand is rounded and flows easily. The problem with some fillers is that they easily wet and have a high affinity for water, which can be a problem with some applications. Therefore, a process was developed of treating the sand with a solution of a low viscosity organic polymer, prior to its mixture with the liquid component. In particular, an isocyanate was used. 150 pounds of F-50 sand (manufactured by U.S. Silica Co., U.S.A.) having a mesh size of 50 was treated with 140 grams of Polymeric MDI (RUBINATE® 9433 manufactured by Huntsman Corporation, USA) and 50 grams of carbon black.

[0034] It is often desirable to employ minor amounts of certain other compounds in preparing the liquid composition, such as: one or more catalysts, surfactants, fire retardants, preservatives, pigments (including titanium or aluminum dioxide, and high UV absorbing ultra-fine titanium dioxide), antioxidants, anti-microbial agents, anti-static agents, and salts, such as sodium chloride. Amounts used can be up to 5% by volume of the total weight of the liquid composition.

[0035] The method of metering and combining the liquid and filler materials of the present invention begins by gravity feeding at least one filler material 14, such as uniformly graded sand, to a pressurized tank 12 through a conduit 18 in the tank 12, the conduit 18 having an orifice 20. Any commercial available tank capable of being pressurized can be used. The tank 12 includes an outlet port or hose 26 connected to a spray gun assembly 30. Any commercially available spray gun assembly can be used. In order to introduce a second filler material, a second pressurized tank is used, comprising the same elements and configuration as the first pressurized tank 12.

[0036] The pressure maintained in the tank 12 was below 35 psi, preferably in the range of about 10-30 psi. Considering inconsistent flow, e.g., pulsing, cannot be remedied at low pressures, it was surprising the present invention was able to introduce the filler material 14 at low pressure, low velocity, and at a precise rate to combine

effectively with the liquid component. The filler material 14 is forced with air pressure through a metering conduit 18 having an orifice 20 and directed up against gravity. For example, if sand is used as the filler material 14, the sand particles are pushed by air against gravity and gradually accelerate to full velocity in turbulent air. The smooth acceleration of the sand eliminates pulsing and sand agglomeration at low pressures. The present invention provides high volume sand with low-volume, low-pressure air, a fluidization of the filler material 14. The influence of gravity is eliminated and a consistent flow rate was achieved by a metering conduit 18 having an orifice 20 shielded from the filler material mass 14 above the orifice 20. The shield creates a fluidized zone where the particles of the filler material 14 are separated from each other by a turbulent airflow. The conduit's orifice 20 preferably has a round shape (see Figures 11 and 12). However, the conduit 18 may be a pipe having a orifice of a number of shapes and diameters, such as a funnel shape (Fig.10). Air moving against gravity through the filler material mass 14, e.g., sand, creates a vacuum behind each particle. This vacuum eliminates the friction between the particles 14 to allow high volume fillers flow at low pressurized and low volume airflow.

[0037] Both the inlet end of the spray gun assembly 30 and the filler tank 12 are connected to a compressed air supply 24 via conduits or hoses, 26, 27, respectively (Figure 1). The air pressure is in the range of about 5-30 psi, preferably between about 10-20 psi. The compressed air supply 24 preferably includes a dryer and pressure gauge for the tank 12. The sand 14 is suspended in a turbulent air stream in the conduit 18 for delivery (FIG. 3). The metering and delivery of the filler 14 is controlled by the orifice 20 size/diameter, the hose 18 size, and the air pressure. The temperature of the filler 14 can also be increased depending on the desired outcome. The liquids are metered with a variable speed metering pump 17. A rheostat controls the speed of a motor that drives the pump 17. To increase liquid volume, the speed of the motor is increased and to decrease the volume, the motor speed is decreased. Standard commercially available hoses and fittings, air dryer, pump(s), pump drive motor, and control, can be used. In particular, the hoses 26, 27, and 28 used were low friction, translucent, low pressure hoses made of polyethylene, polypropylene, PVC, and TEFLON (manufactured by DuPont, USA).

[0038] If two liquids components 16 are to be combined, two gear pumps are linked to a single motor. The motor is connected to a spray gun assembly 30 and thus, the two liquid component streams are combined in a static mixer 38 to create the reactive liquid (FIG.1). Two non-reactive liquids may also be combined, although they may be mixed in a single container and then pumped to the spray gun 30. For example, if a two component polymeric composition is used, such as used for polyurethane, component A and B are heated to a temperature of about 40°F to 80°F, preferably 70°F.

[0039] Component B contains a polyol. Any additional catalysts, surfactants, blowing agents, e.g. water or an alcohol/water mixture may be either added to component B, prior to its reaction with component A, or may be added to the mixture of component A and component B. Component A is supplied by pump 17 to a metering unit, or a metering pump. Component B is also supplied by pump 17 to a metering unit, or a metering pump. The metering pumps boost the pressure and control the flow of components A and B to a precise ratio as determined by the desired chemistry. The ratio of isocyanates, side A components, to polyols, side B components is from about 10 to 1 by volume, preferably from about 1 to 1. The pumps deliver components A and B to the inner chamber 36 of the spray gun nozzle 32 where they are mixed. Inside the spray nozzle 32, components A and B are statically mixed at high pressure, which results in intimate mixing of the components. The mixed liquid composition travels through the center inner chamber 36 of the spray nozzle 32 to the spray tip (FIGS. 5, 6a-d, 7, 8, and 9).

[0040] The fillers 14 are suspended in turbulent air in a cylindrical pattern. The filler material 14 is simultaneously passed through the outer chamber 34, which circumferentially surrounds the inner chamber 36 (FIG. 5 and 7). Upon leaving the spray gun's nozzle, the liquid composition stream is atomized (with or without air) in the center of the suspended fillers 14 in a conical or fan pattern (FIG. 2). The pot life or working time of the mixed liquid composition is variable, typically in the range of about 10-15 minutes, when typically the compositions takes about 10 seconds to react. Upon spraying, the liquids and fillers intersect and combine. Sand acts as a heat sink to absorb energy from the cure therefore preventing polymer from decomposing from heat

after it is sprayed. Therefore, low molecular weight components can be used in the present invention.

[0041] The polymeric composition of the present invention may be sprayed or poured in any thickness, typically from about 1/16 to 1/4 inch in one application, depending on the project needs. Typically when surfacing a large area during a spray application, the composition cures quickly, making it difficult to pickup spraying again without seeing the seam where one application pass started and the other began. It was unexpectedly found that during the application process of the present invention, a feathered edge could be created during the end of one application and the beginning of another, thus creating a seamless surfacing.

[0042] When performing asphalt repair, a liquid rich composition is used. The liquid content is about 18% of the total composition of the present invention, which allows the composition to be easily spread over the cracks in the asphalt. The liquid content is lowered to about 10% of the total composition when creating a new surface, i.e., when it is not necessary to spread the composition thinly.

[0043] Surface preparation of an object to be resurfaced

[0044] The present invention requires that the object to be surfaced is clean and dry. The composition of the present invention bonds to painted surfaces, such as truck beds, without a need to sand the surface or to remove the paint.

[0045] EXAMPLE 1- FILLER TREATMENT

[0046] 150 pounds of F-50 sand (manufactured by U.S. Silica Co., U.S.A.) having a mesh size of 50 was treated with 140 grams of MDI (RUBINATE® 9433 manufactured by Huntsman Corporation, USA) and 50 grams of carbon black.

[0047] EXAMPLE 2- BEDLINER

[0048] The treated sand of Example 1 was placed in a holding tank 12 that was pressurized with compressed air at about 10-30 psi. Moisture affects the sand flow, therefore the sand and compressed air were kept dry. The compressed air supply 24

included a suitable air dryer. The sand flow and sand velocity was controlled by air pressure, the length and size of the conduits 18, 27, e.g. hoses, carrying the compressed air to and from the holding tank 12, and the diameter and shape of the orifice 20 of the conduit 18 carrying the filler 14 from the tank 12 to a spray gun or other dispenser 30. The sand quantity was controlled by air pressure, sand size, and the diameter and shape of the orifice 20 carrying the filler 14.

[0049] The side A reaction component, an isocyanate, was comprised of 75.00% MDI (RUBINATE® 9433 manufactured by Huntsman Corporation, USA); 20.00% Poly G 55-37 (manufactured by Arch Chemical Co., U.S.A.); and 5.00% diisononyl phthalate (DINP). The side B reaction component, a polyol, comprised 58.56% of Poly G 85-36 (manufactured by Arch Chemical Co., U.S.A.); 26.12% of a premix of diethylene glycol (DEG) and phenyldiethanolamine (PDEA) (the premix comprised 50.0% of DEG and 50.0% of PDEA); 10.00% of Quadrol®; 4.00% of black carbon paste; 1.00% of a desiccant (3A molecular sieves); 0.10% of C-231 (ferric acetylacetonate); and 0.22% of C-232 (bismuth). The side A and B components were at ambient temperature. The isocyanate and the polyol were in an about 1:1 ratio by volume. During the spraying of the composition, the pressure remained constant, at about 10-30 psi. The resulting bedliner produced from this process comprised of 50% of the treated sand from Example 1 and 50% of the polymer described above.

[0050] EXAMPLE 3-4

[0051] The procedure of example 2 was followed by substituting the following filler materials 14 for the treated natural 50 mesh sand: natural 30 mesh sand and natural 60 mesh sand. The resulting product produced from this process and made with manufactured 30 mesh sand had a density of about 1.5.

[0052] EXAMPLE 5

[0053] The procedure of example 2 can be followed by substituting the following filler materials 14 for the treated natural 50 mesh sand: glass beads, or a combination of glass beads, natural 30 mesh, 50 mesh, or 60 mesh sand.

[0054] EXAMPLE 6 – INDUSTRIAL FLOORS

[0055] The procedure for example 2 was followed with the addition of second filler material 14, a natural 12 mesh sand. A second container holding the 12 mesh sand was used. The smaller mesh sand fell to the bottom of the lining or coating, leaving the larger mesh sand toward the top surface of the lining or coating, allowing for the coated surface to have better traction. The resulting coating produced from this process comprised about 18% polymer composition and about 82% of the treated sand from Example 1 and had a density of about 2.0.

[0056] EXAMPLE 7

[0057] The procedure of example 6 can be followed by substituting the following filler materials 14 for the treated natural 12 and 50 mesh sand: glass beads, or a combination of glass beads, natural 30 mesh, 50 mesh, or 60 mesh sand.

[0058] EXAMPLE 8- ASPHALT REPAIR

[0059] The treated sand of Example 1 was placed in a holding tank 12 that was pressurized with compressed air at about 10-30 psi. Moisture affects the sand flow, therefore the sand and compressed air were kept dry. The compressed air supply 24 included a suitable air dryer. The sand flow and sand velocity was controlled by air pressure, the length and size of the conduits 18, 27, e.g. hoses, carrying the compressed air to and from the holding tank 12, and the diameter and shape of the orifice 20 of the conduit 18 carrying the filler 14 from the tank 12 to a spray gun or other dispenser 30. The sand quantity was controlled by air pressure, sand size, and the diameter and shape of the orifice 20 carrying the filler 14.

[0060] The side A reaction component comprised 71.50% Polymeric MDI (RUBINATE® 9258 manufactured by Huntsman Corporation, USA) and 28.50% of a plasticizer, such as 2,2,4-trimethyl-1,3-pentanediol diisobutyrate (TXIB). The side B reaction component, a polyol, comprised 75.42% of a primary diol, such as Poly G 55-173 (manufactured by Arch Chemical Co., U.S.A.); 17.43% of a premix of diethyleneglycol (DEG) and triisopropylene butanediol (TIPA) (the premix was made up

of about 45.4% DEG and 54.6% TIPA); 5.00% black carbon paste; 1.00% of a desiccant, such as 3A molecular sieves; 1.00% A-450 (Epoxy silane); 0.10% C-231 (Ferric acetylacetonate); and 0.05% bismuth (C-232). The A and B components were at ambient temperature. The isocyanate and the polyol were in an about 1:1 ratio by volume.

[0061] EXAMPLE 9

[0062] The procedure of example 8 was followed by substituting the following filler materials 14 for the treated natural 50 mesh sand: 12 mesh sand or a combination of 12 mesh and 50 mesh sand.

[0063] EXAMPLE 10

[0064] The procedure of example 8 can be followed by substituting the following filler materials 14 for the treated natural 50 mesh sand: 30 mesh sand, 60 mesh sand, glass beads, or a combination thereof.

[0065] EXAMPLE 11- POLYMER FLOORING

[0066] The filler pre-treatment procedure of example 1 was followed to obtain the filler material. A premix was then made comprising 58.59% TIPA and 44.41% Butanediol. The side A reaction component comprised 71.50% MDI (RUBINATE® 9433 manufactured by Huntsman Co., U.S.A.); 14.25% Poly G 55-56 (manufactured by Arch Chemical Co., U.S.A.); and 14.25% TXIB (S-142). The side B reaction component comprised 18.24% of the TIPA/Butanediol premix; 5.00% Quadrol®; 30.00% Poly G 55-173 (manufactured by Arch Chemical Co., U.S.A.); 25.90% TXIB (S-142); 14.25% Poly G 55-56 (manufactured by Arch Chemical Co., U.S.A.); 4.00% White paste; 0.50% black carbon paste; 1.00% 3A Mol sieves; 0.50% A-450 (Epoxy silane); 0.50% A-500 (defoamer); 0.10% C-231 (Ferric acetylacetonate); and 0.01% C-232 (Bismuth).

[0067] EXAMPLE 12

[0068] The procedure of example 12 was followed by substituting glass beads for the treated natural 50 mesh sand.

[0069] EXAMPLE 13-CONCRETE FLOORING REPAIR

[0070] The filler pre-treatment procedure of example 1 was followed to obtain the filler material, substituting a 50:50 mixture of 12 and 50 mesh sand for the 50 mesh sand. A premix was then made comprising 58.59% TIPA and 44.41% Butanediol. The side A reaction component comprised 71.50% MDI (RUBINATE® 9433 manufactured by Huntsman Co., U.S.A); 10.7% Poly G 55-56 (manufactured by Arch Chemical Co., U.S.A.); and 18.43% TXIB (S-142). The side B reaction component comprised 18.24% of the TIPA/Butanediol premix; 5.00% Quadrol®; 30.00% Poly G 55-173 (manufactured by Arch Chemical Co., U.S.A.); 25.90% TXIB (S-142); 14.25% Poly G 55-56 (manufactured by Arch Chemical Co., U.S.A.); 10.00% White paste; 1.00% black carbon paste; 2.00% 3A Mol sieves; 0.50% A-450 (Epoxyasilane); 0.50% A-500 (defoamer); 0.05% C-231 (Ferric acetylacetonate); and 0.005% C-232 (Bismuth).

[0071] The filler materials were treated prior to preparing the composition of the present invention. 100 pounds of F-50 sand (manufactured by U.S. Silica Co., U.S.A.) having a mesh size of 50 and natural 12 mesh sand was treated with 140 grams of pure MDI (RUBINATE® 9433 manufactured by Huntsman Corporation, USA). A 50:50 mixture of the treated 12 and 50 mesh sand was combined. The 50:50 ratio of the two fillers 14 provided the best flow. A 50 pound kit comprising the composition of the present invention was prepared, the kit comprising about 9 pounds of the polymer composition and about 41 pounds of the treated sand mixture.

[0072] EXAMPLES 14-22

[0073] Example 2 can be followed by substituting the following filler materials 14 for treated natural 50 mesh sand: garnet; aluminum oxide; fibers, such as KEVLAR or carbon fullerenes; tungsten carbide; powdered plastics; ceramic spheres; powdered metals; or hollow spheres.

[0074] The following references are incorporated herein by reference: U.S. patents to Hall et al, No. 5,307,992; to Mathias et al., No. 5,565,241; to Scarpa, No. 5,979,787; to Mobley et al., No. 1,849,945; to Thompson, No. 2,981,308; to Tufts, No. 3,606,154; to

Medlin, No. 4,630,929; to Daluise, No. 6,159,550; to Uribe, No. 5,213,271; to Reimer, No. 5,282,573; to Moller, No. 2,565,696; to Lippert et al., No. 3,251,550; to Sandell, No. 4,263,346; to Shockley, No. 3,799,438; to Williams, No. 5,167,285; to Scarpa et al., No. 5,964,418; to Larsen et al., No. 6,105,822; German patent 1,577,773 to Hill; and U.S. Patent to Vass, No. 5,532,281.

[0075] Although the foregoing invention has been described in some detail by way of illustration and example for purposes of clarity and understanding, it will be obvious that various modifications and changes which are within the knowledge of those skilled in the art are considered to fall within the scope of the appended claims.

FOOTNOTES